A NEW SPECIES OF *HYPOLYCAENA* C. & R. FELDER (LEPIDOPTERA: LYCAENIDAE) FROM AUSTRALIA AND ITS RELATIONSHIP WITH *H. PHORBAS* (FABRICIUS)

TREVOR A. LAMBKIN[1], CLIFFORD E. MEYER[2], STEPHEN S. BROWN[3], RICHARD P. WEIR[4], JOHN F. DONALDSON[1] and A. IAN KNIGHT[5]

[1]*Queensland Department of Primary Industries and Fisheries, 80 Meiers Road, Indooroopilly, Qld 4068 (Email: Trevor.Lambkin@dpi.qld.gov.au)*

[2]*10 Anne Clark Avenue, Nicholls, ACT 2913*

[3]*19 Kimberley Drive, Bowral, NSW 2576*

[4]*1 Longwood Avenue, Leanyer, Darwin, NT 0812*

[5]*70 Exton Road, Exton, Tas 7303*

Abstract

Hypolycaena litoralis sp. n. and its life history are described and illustrated from Torres Strait, Queensland. It belongs to the 'branded' *Hypolycaena* C. & R. Felder group, with males possessing a sex brand (a patch of androconial scales) on the forewing upperside and their larvae attended by the ant *Oecophylla smaragdina* (Fabricius). The 'branded' *Hypolycaena* species that occur in the region are reviewed and the external facies and genitalia of *H. litoralis* are found to most closely resemble those of *H. phorbas* (Fabricius). Adults and early stages are compared with *H. phorbas* and the differences between the two species discussed. The behaviour of adult and larval *H. litoralis* is documented and a description of the species' habitat included. Host plants are mangroves, *Rhizophora stylosa* Griff. and *Bruguiera* Sav. sp. (Rhizophoraceae). Currently, *H. litoralis* is known from Boigu, Dauan, Saibai and Yam Islands, Torres Strait.

Introduction

The genus *Hypolycaena* C. & R. Felder occurs in the Afrotropical and Indo-Australian regions, with about 30 species known (Parsons 1998). The genus is particularly diverse in tropical Africa. Closer to Australia, six species occur in Papua New Guinea, of which two extend into tropical Australia (Braby 2000). Parsons (1998) summarised the current view concerning the placement of particular species within *Hypolycaena*. He pointed out that Corbet and Pendlebury (1978) and D'Abrera (1978) both recognised two widely separate groups of species: the 'true' *Hypolycaena* (as in the type species *H. sipylus* (C. Felder)) that lack a sex brand on the forewing and with larvae that have no association with ants and feed exclusively on orchids, and the 'branded' *Hypolycaena*, characterised by possessing a sex brand on the forewing, exhibiting a high degree of sexual dimorphism and with polyphagous larvae closely associated with *Oecophylla* Smith ant species.

Four 'branded' *Hypolycaena* species occur in the Australian region: *H. erylus* (Godart), *H. periphorbas* Butler, *H. phorbas* (Fabricius) and *H. dictaea* C. & R. Felder. The only species currently recognised in Australia is *H. phorbas* (Braby 2000). Parsons (1998) also recorded *H. dictaea* from 'as far south-east as Queensland'; however, a review of specimens in The Natural History Museum, London and the Australian National Insect Collection (ANIC), Canberra by the authors has failed to support this claim.

A further species, *H. noctula* (Staudinger), was described from two 'dark grey tinted slightly bluish' males from Cooktown, Queensland (Staudinger and Schatz 1888). Waterhouse (1903) initially agreed with Staudinger and Schatz (1888) in recognising *H. noctula* but later (Waterhouse and Lyell 1914) synonymised this species with *H. phorbas*. Tindale (1923) agreed with this synonymy and it is accepted in this work. *H. noctula* and *H. phorbas* share the same type locality (Edwards *et al.* 2001).

In 1984, several small, dark 'branded' *Hypolycaena* males closely resembling *H. phorbas* were collected by C.G. Miller and J.W. d'Apice on Yam Island in Torres Strait, Queensland. Additional specimens were collected over the next decade on other Torres Strait islands. Because the facies and size of *H. phorbas* are known to be variable (Parsons 1998, Braby 2000), these specimens were presumed, until recently, to be diminutive examples of *H. phorbas*, which also occurs on the same islands. A review of *Hypolycaena* from the Indo-Australian region (Corbet and Pendlebury 1978, D'Abrera 1978, Parsons 1998), plus an examination of Papua New Guinea material in the Brandt Collection (in ANIC) by one of us (CEM), indicated that this small, dark 'branded' *Hypolycaena* might be distinct.

In April and May 2002, all immature stages of this small *Hypolycaena* were discovered by one of us (CEM) on Dauan and Saibai Islands on *Rhizophora stylosa* Griff. (Rhizophoraceae) and were successfully reared to adults. Further examination of this species' external facies, genitalia and life history confirmed that it was undescribed.

Abbreviations of specimen depositories are: ANIC - Australian National Insect Collection, Canberra; CEMC - C.E. Meyer collection, Canberra; CGMC - C.G. Miller collection, Lennox Head; JFDC - J.F. Donaldson collection, Thornlands; TLIKC - Joint T.A. Lambkin and A.I. Knight collections, Brisbane; JWDC - J.W. d'Apice collection, ANIC, Canberra; MDBC - M. De Baar collection, Brisbane; MTQ - Museum of Tropical Queensland, Townsville; PSVC - P.S. Valentine collection, Townsville; QM - Queensland Museum, Brisbane; RPWC - R.P. Weir collection, Darwin; SSBC - S.S. Brown collection, Bowral. Abbreviations of collectors are: AIK - A.I. Knight; CEM - C.E. Meyer; CGM - C.G. Miller; JFD - J.F. Donaldson; JWD - J.W. d'Apice; PSV - P.S. Valentine; RPW - R.P. Weir; SJJ - S.J. Johnson; SSB - S.S. Brown; TAL - T.A. Lambkin.

Hypolycaena litoralis Lambkin, Meyer, Brown & Weir, sp. n.

Mangrove Flash (Figs 1-4, 9-12, 17-18, 21-29)

Types. *Holotype* ♂, AUSTRALIA (QUEENSLAND): labelled 'Boigu Island, Torres Strait, Q. 8-9.iv.1992, T.A. Lambkin' (in QM, Registration No. T.123514). *Paratypes*: 3 ♂♂, 3 ♀♀, same data as holotype except 21.iii.1994 (3 ♂♂, 1 ♀ TLIKC, 1 ♀ ANIC, 1 ♀ MDBC); 23 ♂♂, 14 ♀♀, Dauan Island, Torres Strait, 9.v.2001 (9 ♂♂, 9 ♀♀), 27.iv.2000 (♂), 11.iv.2001 (♂), 1.v.2001 (3 ♂♂), 10.v.2001 (♂), 11.v.2001 (5 ♂♂, 2 ♀♀), 12.v.2001 (♀), 13.v.2001 (3 ♂♂, 2 ♀♀) AIK (TLIKC); 2 ♂♂, same data except

17.ii.2004 (pupa collected) TAL (TLIKC); 14 ♂♂, 8 ♀♀, same data except 13-18.iv.2001 (1 ♂, 1 ♀), 26.iv.-2.v.2002 (7 ♂♂, 4 ♀♀), Emg: 3.v.2002 (♀), Emg: 5.v.2002 (♂), Emg: 12.v.2002 (♂), Emg: 14.v.2002 (♂), Emg: 16.v.2002 (♂), Emg: 10.vi.2002 (♀), Emg: 12.vi.2002 (♂), Emg: 18.vi.2002 (♂), Emg: 7.vii.2002 (♀), CEM (CEMC); 1 ♂, same data except 4.iv.1990, JFD (JFDC); 9 ♂♂, 6 ♀♀, same data except 13.iv.1994 (♂), 9°24S, 142°32E, 4.iv.2004 (♂), 9.iv.2004 (2 ♂♂), 12.iv.2004 (4 ♂♂, 1 ♀), emerged 12.iv.2004 (2 ♀♀), emerged 13.iv.2004 (♀), emerged 14.iv.2004 (♀), emerged 16.iv.2004 (♂), emerged 23.iv.2004 (♀), PSV (PSVC); 8 ♂♂, 8 ♀♀, same data except 9.412S, 142.529E, 10.iv.2004 (2 ♂♂, 1 ♀), emerged 12.iv.2004 (♀), emerged 14.iv.2004 (1 ♂, 2 ♀♀), emerged 18.iv.2004 (1 ♂, 3 ♀♀), emerged 19.iv.2004 (3 ♂♂), emerged 20.iv.2004 (♀), emerged 22.iv.2004 (♂), SJJ (MTQ); 7 ♂♂, 6 ♀♀, same data except 9°24'46"S, 142°32'19"E, 26.iv-2.v.2002 (2 ♂♂, 1 ♀), 26.iv-2.v.2002, em 3.v.2002 (3 ♀♀), 26.iv-2.v.2002, em 4.v.2002 (3 ♂♂, 1 ♀), 26.iv-2.v.2002, em 5.v.2002 (2 ♂♂, 1 ♀), RPW, SSB & CEM (RPWC); 18 ♂♂, 9 ♀♀, same data except 13-18.iv.2001 (1 ♂, 1 ♀), 26.iv-2.v.2002 (17 ♂♂, 7 ♀♀), 5.v.2002 (ex pupa) (♀), SSB (SSBC); 2 ♂♂, Saibai Island, Torres Strait, 27.ix.1992, 22.iii.1994, TAL (TLIKC); 1 ♂, 1 ♀, same data except 9.v.2001 (♂), 27.ii.2004 (♀) AIK (TLIKC); 2 ♂♂, 2 ♀♀, same data except 19-20.iv.2001 (1 ♂, 2 ♀♀), 25.iv.2001 (♂), CEM (CEMC); 2 ♂♂, same data except 3-4.v.2002, SSB (SSBC); 2 ♂♂, Yam Island, Torres Strait, 3.iv.1984, CGM (CGMC); 2 ♂♂, same data except JWD (JWDC); 10 ♂♂, same data except 12.vi.1992, AIK (1 ♂ ANIC, 3 ♂♂ JFDC, 6 ♂♂ TLIKC). All specimens are documented as vouchers in Appendix 1 (♂♂) and Appendix 2 (♀♀).

Description. Male (Figs 1, 3). Forewing length 13.14 mm [n=106]. Forewing upperside ground colour dull black, largely covered, most often with deep blue-purple but sometimes blue central area enclosing a velvety black sex brand, variable in size and shape but never circular; sex brand rarely extending below vein CuA_2 and almost always overlaid by a line of blue-purple scales in the area between veins CuA_1 and CuA_2; rarely with white markings on the forewing in the area below the sex brand above vein 1A+2A. Hindwing upperside variably suffused with blue-purple; a series of faint white subterminal lunules sometimes occurring up to vein M_2 but, when present, always poorly defined; the two lunules nearest the tornus always present and each enclosing a black spot; tornal lobe dull black, sometimes with a dull orange centre; a fine white terminal line running from the tornal lobe up to but not past vein M_2; termen with two black tails tipped white at veins CuA_2 and 1A+2A. Forewing underside ground colour pale grey, with a short pale brown to grey band at end of cell; a similar almost straight post median band faintly edged with white; a faint pale grey subterminal band. Hindwing underside ground colour pale grey, with a dark grey or black basal spot; a short pale brown to grey band at end of cell; an irregular yellow-brown post median band faintly edged with white finishing at tornus; two black spots near tornus each edged above with pale orange.

Male genitalia (Figs 17-18). Sociuncus slightly convex in lateral view with acute ventral angle, concave in ventral view; brachium in ventral view long, tapering, curved with extreme apex bent; valva long, with thumb-like process

near apex, in lateral view tapering with acute apical portion bent dorsally, in ventral view slightly sinuate with apical portion curved laterally, basal lateral extension of valva short and rounded; ventral-lateral carina usually only slightly developed, never strongly laminate (n=6, voucher specimens 14, 23 [Holotype], 24, 25, 31 and 32 [Appendix 1]).

Female (Figs 2, 4, 29). Forewing length 13.67 mm [n=57]. Forewing upperside ground colour ranging from dull grey-black to grey-brown, rarely with a trace of white in the central area of the forewing. Hindwing upperside with a series of dull black subterminal spots with no obvious white lunules enclosing them; a fine white terminal line running from the tornal lobe up to but not past vein M_1; tornal lobe dull black enclosing a very small dull orange centre; tails as for male. Underside as in male, but ground colour paler.

The underside ground colour and wing patterns are variable in both sexes.

Distribution. This species is known from Boigu, Dauan, Saibai and Yam Islands, Torres Strait, Queensland.

Etymology. The specific name is derived from the Latin noun *litus* meaning 'shore' and refers to the littoral zone or seashore environment where this species occurs.

Life history

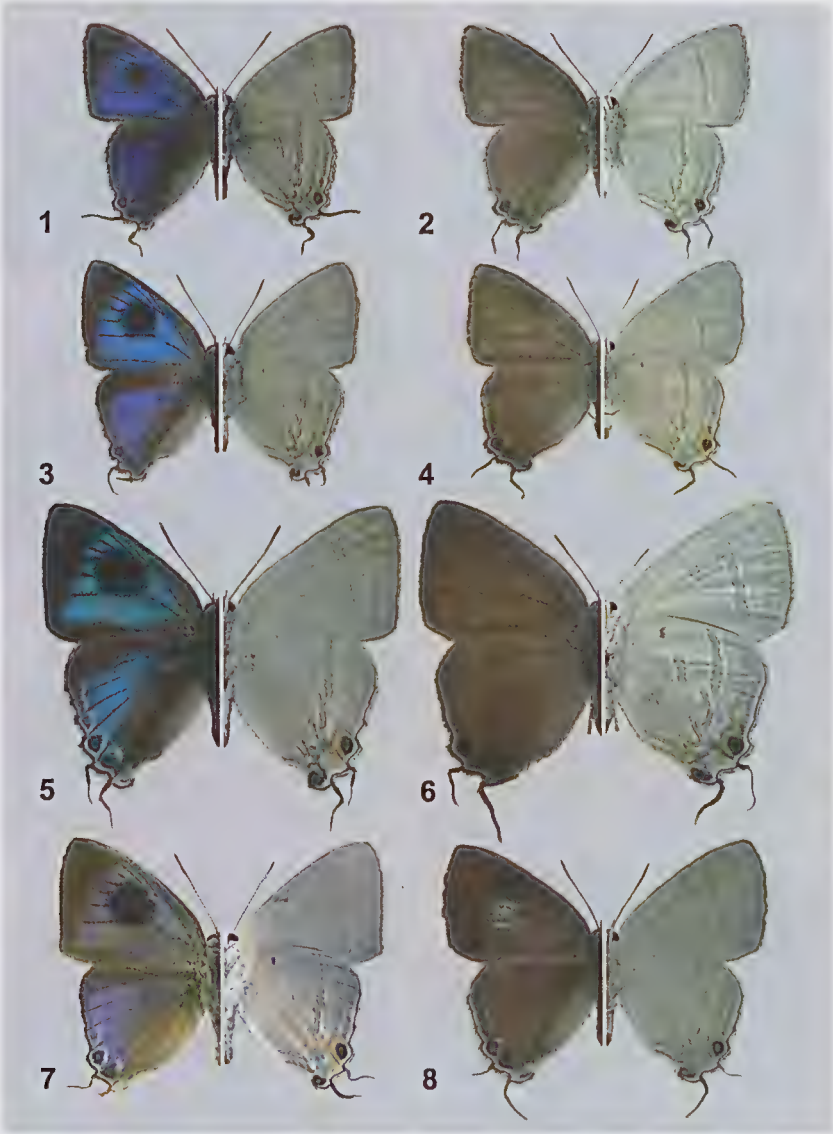
Host plants (Figs 30-32). *Rhizophora stylosa* Griff. and *Bruguiera* Sav. sp. (Rhizophoraceae).

Attendant ant (Figs 24, 28). *Oecophylla smaragdina* (Fabricius), green tree ant, brown form (Formicidae).

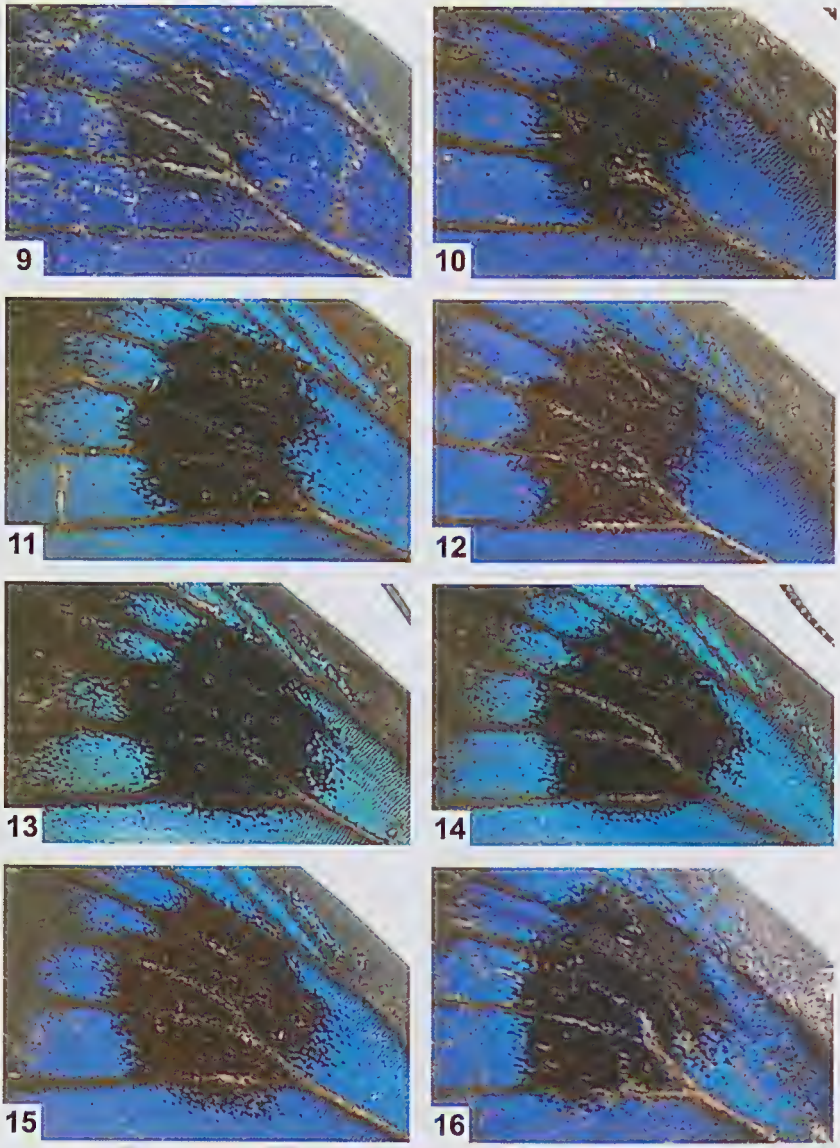
Egg (Figs 21-22). Width 0.65 mm, height 0.36 mm [n=1]; white, mandarin-shaped; micropylar depression smooth with no ornate features; egg surface with a pattern of reticulated pits and intervening ridges with tops of ridges obtuse and granulated.

First instar larva (Fig. 23). Length 1.0 mm [n=3]; body smooth and onisciform, pale green with no distinctive external features except for the body contents, visible through the cuticle, appearing as a broad dark green dorsal stripe extending from the first mesothoracic to the last abdominal segment.

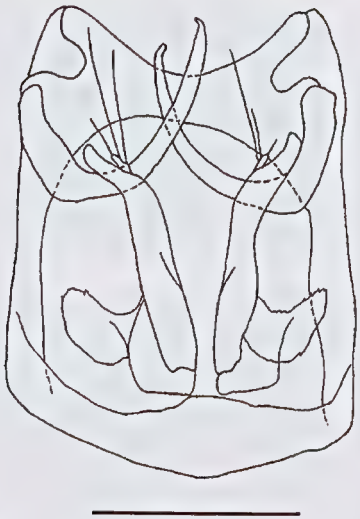
Final instar larva (Figs 24-25). Length 17.0 mm [n=7]; head orange; body onisciform and elongate; body, including prothoracic and anal plates, varying in colour from pale to dark green; pale green lateral and dorsolateral stripes; two faint white dorsal stripes edged reddish brown; a central dorsal dark green stripe; spiracles orange; dorsal surface of first mesothoracic segment orange; area between dorsolateral eversible organs on abdominal segment 8 orange; legs and prolegs, including bases, pale green; prothoracic plate, anal plate, leg and proleg bases edged in fine pale secondary setae.



Figs 1-8. *Hypolycaena* spp. All figures to scale, upperside left, underside right [forewing lengths in parentheses]. (1-4) *H. litoralis* with voucher specimen numbers (VS): (1, 3) males: (1) Dauan I., AIK [13 mm] VS 4; (3) Boigu I., TAL [15 mm] VS 9; (2, 4) females: (2) Dauan I., AIK [15 mm] VS 1; (4) Boigu I., TAL [15 mm] VS 15. (5-8) *H. phorbas*: (5, 7) males: (5) Dauan I., 11.v.2001, AIK [18 mm]; (7) Boigu I., 8-9.iv.1992, AIK [16 mm]; (6, 8) females: (6) Saibai I., 22.ii.1994, TAL [20 mm], (8) Boigu I., 8-9.iv.1992, TAL [17 mm] (all TLIKC).



Figs 9-16. Sex brands of *Hypolycaena* spp. [width of brands in parentheses]. (9-12) *H. litoralis*: (9) Dauan I., 11.v.2001, AIK [2.0 mm]; (10) Dauan I., 1.v.2001, AIK [2.3 mm]; (11) Yam I., 11-12.vi.1992, AIK [3.4 mm]; (12) Boigu I., 9.iv.1992, TAL [3.3 mm]. (13-16) *H. phorbas*: (13) Bamaga, Qld, 15.iv.1995, TAL [4.2 mm]; (14) Saibai I., 10.iv.2001, AIK [6.0 mm]; (15) Kemp Beach, Yeppoon, Qld, 3-4.i.1979, TAL [5.2 mm]; (16) East Point, Darwin, NT, 28.iv-3.v.1993, AIK [5.2 mm].



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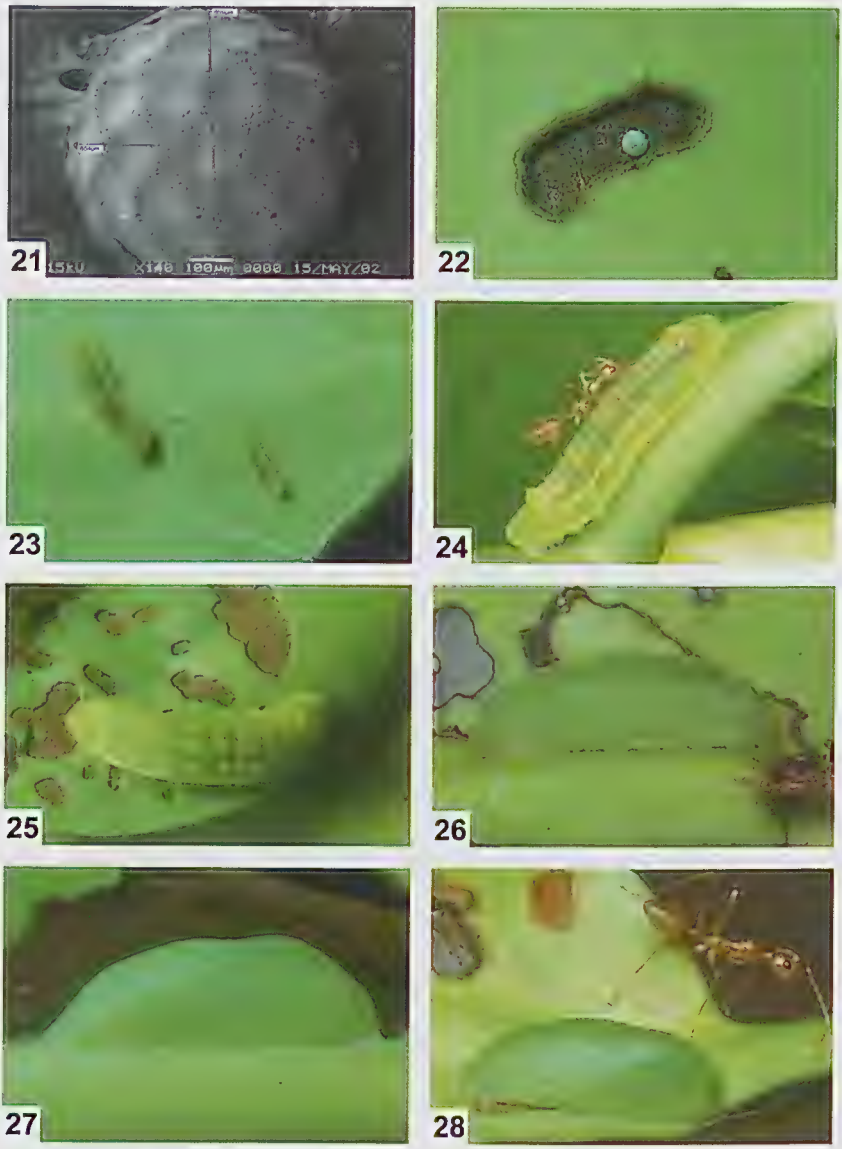
Figs 17-20. Male genitalia of *Hypolycaena* spp. with scale bar lengths. (17-18) *H. litoralis* (Holotype [VS 23]): (17) ventral view, 0.5 mm; (18) valva, 0.2 mm. (19-20) *H. phorbas* (Yeppoon, Qld, 12.v.1995, AIK): (19) ventral view, 0.5 mm; (20) valva, 0.2 mm.



Figs 21-28. *Hypolycaena litoralis*. (21) SEM image of egg [diameter 0.65 mm]; (22) egg in situ; (23) dorsal view of first instar larva, RHS larva [length 1.5 mm]; (24-25) final instar larvae: (24) dorsolateral view [16 mm] with attendant ant, *Oecophylla smaragdina*; (25) dorsal view [18 mm]; (26) prepupa, lateral view [13 mm]; (27-28) pupae: (27) lateral view [11 mm], (28) dorsolateral view [10 mm] with attendant ant.

Pupa (Figs 27-28). Length 11.8 mm [n=8]; smooth, slender, oblong; thoracic and abdominal dorsal humps slight; lime-green, including spiracles; no distinctive colour or surface features, *i.e.* without mottling or fine speckling.

Biology

The habitat of *H. litoralis* on Dauan Island (Fig. 33) consists of mangroves, predominantly *R. stylosa*, backing onto brackish areas where *Gymnanthera oblonga* (Burm. F.) P.S. Green (Asclepiadaceae) is a common component. These brackish areas are mixed with sparse vine thicket where *Premna serratifolia* L. (Lamiaceae) and *Pongamia pinnata* (L.) Pierre (Fabaceae) commonly grow. On all four islands, *H. litoralis* appears to be confined to these habitats where, in mangroves, its host plants *R. stylosa* and *Bruguiera* sp. (S.J. Johnson pers. comm.) and its attendant ant species occur. Females are most often seen flying around their host plant and, together with males, also fly along mangrove edges. Both sexes have a fast and direct flight, settle frequently and readily come to blossom. In April and May 2001, they were collected commonly from blossom of *P. serratifolia*. The environment and host plants of *H. litoralis* prompted our choice for its common name, Mangrove Flash.

Eggs of *H. litoralis* are deposited singly on the underside of mature leaves of *R. stylosa*, or in old larval leaf scars on the underside of mature leaves (Fig. 22). Young larvae were only found feeding on the terminal fresh growth and it is surmised that they travel to the terminal ends of the stems soon after hatching. In February 2004, the observed biology of *H. litoralis* was very similar to that of *H. phorbas* (Braby 2000), in that all larval and pupal stages were found together in close association with *O. smaragdina* in temporary ant shelters, at the terminal ends of the branches. The ants constructed these shelters by stitching the top four or five terminal leaves together in an upward direction (Fig. 32) and within these shelters the ants attended all stages of *H. litoralis*. In contrast, its biology appeared to be quite different to that of *H. phorbas* when observed in April and May 2002. There was no evidence of attendant ants constructing webbing or shelters around the larvae, with larvae most often found isolated from the ants or in the presence of only one or two. Furthermore, pupae were typically found singly on the underside edges of leaves toward the stems, with no ant attendance.

In general, immature stages were found on small *R. stylosa* plants (1-2 m high) as well as on larger trees (8 m high). Larval feeding causes the leaves of *R. stylosa* to twist and turn brown and this gives infested plants a scorched appearance (Fig. 31). Colonies of *H. litoralis* were isolated and localised within mangrove patches but, overall, they were easily located.

Discussion

In addition to the types of *H. litoralis* (see Appendices 1 and 2; 6 with male genitalia examined), the following comparative material was examined:

H. periphorbas - 7 ♂♂, 2 ♀♀ from mainland Papua New Guinea.

H. dictaea - 4 ♂♂, 2 ♀♀ from Normanby Island, 4 ♂♂, 1 ♀ from Woodlark Island; 1 ♂ from Misima Island; 3 ♂♂ (1 with genitalia examined) from mainland Papua New Guinea.

H. phorbas - 26 ♂♂, 25 ♀♀ (9 with male genitalia examined) from mainland Queensland; 38 ♂♂, 44 ♀♀ (6 with male genitalia examined) from Torres Strait; 39 ♂♂, 38 ♀♀ (3 male genitalia examined) from Northern Territory; 32 ♂♂, 14 ♀♀ from mainland Papua New Guinea.

Common features of both *Hypolycaena* groups that distinguish them from other related genera include: forewing with only 10 veins (*Rapala* Moore and *Deudorix* Hewitson have 11), with no radial branches (R_4 and R_5); eyes hirsute; hindwing with slender tails at the end of veins CuA_2 and 1A+2A and tornal lobes weakly developed (Parsons 1998, Braby 2000). In both sexes, adult *H. litoralis* are superficially similar to the other branded species from Papua New Guinea but appear closest to *H. phorbas*.

In Papua New Guinea *H. erylus* is restricted to the northwest coast and this possibly represents the eastern extremity for the species (Parsons 1998). *H. periphorbas* has been recorded only from the northeastern provinces (Parsons 1998). *H. erylus* and *H. periphorbas* have not been recorded from the Western, Gulf or Central Provinces, *i.e.* those provinces closest to Torres Strait where *H. litoralis* is known to occur. *H. dictaea* has been recorded from Central Province (Port Moresby) (Parsons 1998, Brandt Collection in ANIC). Males and females of these three species differ from *H. litoralis* in their size and in differences in wing colouring and pattern.

A small male of *H. dictaea* (forewing length 14 mm) in the Brandt Collection, labelled 'Port Moresby, Mt Lawes 1300 ft', superficially resembles the males of *H. litoralis* in size; however it differs by having the upperside ground colour dull purple with dull grey-black margins, a more rounded forewing apex and a less distinct sex brand radiating outwards along the forewing veins towards the termen. This specimen is also morphologically different from the other males of *H. dictaea* in the Brandt Collection and may represent a separate species.

Males of *H. litoralis* (Figs 1, 3) are smaller than males of *H. phorbas* (Figs 5, 7) (forewing lengths 13.14 mm [n=106] and 16.3 mm [n=103] respectively); the forewing upperside colour of male *H. litoralis* varies from deep blue-purple to blue but is most often deep blue-purple (94 of 106), rarely with white markings on the forewing in the area below the sex brand above vein 1A+2A (2 of 106) and the hindwing upperside is always deep blue-purple; the upperside of *H. phorbas* is never deep blue-purple and often has white forewing markings. The sex brand of *H. litoralis* is relatively small and variable in size and shape but never circular, rarely extending below vein CuA_2 (6 of 106) and most often overlaid with a line or a dusting of blue-purple forewing scales in the area between veins CuA_1 and CuA_2 (89 of 106)

Figs 29-33. (29) Newly emerged *Hypolycaena litoralis* female [forewing length 13 mm]; (30-32) *Rhizophora stylosa*: (30) flower [diameter 20 mm]; (31) old larval scarring [largest leaf 140 mm]; (32) larval shelter [100 mm]. (33) habitat of *H. litoralis* on Dauan I.

Figs 34-37. *Hypolycaena phorbas*. (34) SEM image of egg [diameter 0.75 mm], Darwin, NT; (35-36) final instar larvae: (35) lateral views of polymorphic forms, with attendant *Oecophylla smaragdina*, RHS larva [length 18 mm], Thursday I.; (36) dorsolateral view [17 mm], Dauan I. (37) lateral view of pupa [13 mm], Dauan I.

(Figs 9-12); in contrast, the sex brand of *H. phorbas* is consistently and relatively much larger, more circular in shape, always extending to some degree below vein CuA_2 and the area between veins CuA_1 and CuA_2 is never overlaid with forewing scales (Figs 13-16). Finally, the white subterminal lunules on the hindwing upperside of male *H. litoralis* are always poorly defined and sometimes absent (30 of 106) but, when present, rarely extend into the space above vein M_2 (14 of 106); in contrast, the white subterminal lunules of *H. phorbas* are always well defined and almost always extend into the space above vein M_2.

Parsons (1998) considered differences in the hindwing underside subtornal eyespots as characters that can be used to distinguish between adults of *H. erylus*, *H. dictaea* and *H. phorbas* in Papua New Guinea. Parsons (1998) noted that this eyespot was largest in *H. erylus*, intermediate in size in *H. dictaea* and smallest in *H. phorbas*. Furthermore, he noted that the orange area of the eyespot in *H. erylus* had a notably diffuse proximal margin that extended past veins CuA_1 and CuA_2; in *H. phorbas* it was diffuse at its margins and in *H. dictaea* it was rectangular in shape, bounded by veins CuA_1 and CuA_2 and clearly bordered with brown. In *H. litoralis* the size and extent of the orange area of the subtornal eyespot is variable but not

conspicuously rectangular in shape as in *H. dictaea* and, sometimes, the orange area crosses over vein CuA_1, a characteristic that is shared with *H. phorbas* from Australia. Therefore, the subtornal eyespot character is not useful in distinguishing *H. litoralis* from other 'branded' species of *Hypolycaena.*

Of the 'branded' PNG species of *Hypolycaena*, the male genitalia of *H. litoralis* are closest to those of *H. phorbas*; both differ from those of the other species in the shape of valvae and by the valvae possessing short and rounded basal lateral extensions (Figs 17-20). In *H. erylus* these extensions are longer, not projected laterally and their origin is not basal. They are not present in *H. periphorbas* and are long and narrow in *H. dictaea* (Parsons 1998). Parsons (1998) illustrated the male genitalia of the four 'branded' species but his illustrations of *H. phorbas* do not agree with our findings. In this study, we examined the male genitalia of 18 Australian specimens of *H. phorbas* and all had short and rounded basal lateral extensions on the valvae. Parsons' (1998) lateral and ventral illustrations of the genitalia of *H. phorbas* show them having long and narrow basal lateral extensions on the valvae, much like *H. dictaea*. Our conclusion is that his genitalia illustrations of *H. phorbas* are not correct and, considering the similarity of the lateral and ventral views to that of his illustration of *H. dictaea* and our examination of the genitalia of a specimen of *H. dictaea* from mainland Papua New Guinea, it is highly probable that his illustration of *H. phorbas* is actually of *H. dictaea*.

The male genitalia (Figs 17-20) of *H. litoralis* and *H. phorbas* are variable; however, in most cases they can be separated by the extent of the development of the ventro-lateral carina of the valva. In *H. litoralis* this carina is usually just slightly developed, whereas in *H. phorbas* it is well developed, with a strong serrate lamina often running the full length of the carina. Only one of six *H. litoralis* genitalia examined had a small lamina on the base of the ventro-lateral carina. Only one of 18 *H. phorbas* examined showed an apparent lack of a lamina, but a closer examination showed a very narrow lamina running the full length of the carina. Because of this variability, the holotype of *H. litoralis* (VS 23) was selected as the best example showing the slight development of the ventral-lateral carina of the valva. The genitalia of *H. litoralis* are also more delicate in structure and appearance than those of *H. phorbas*.

Female *H. litoralis* (Figs 2, 4) are also smaller than females of *H. phorbas* (Figs 6, 8) (forewing lengths: 13.67 mm [n=57] and 17.11 mm [n=107] respectively). In contrast to the female of *H. phorbas*, the brown-grey forewing upperside of female *H. litoralis* never has central white patches, but occasionally has small areas of white scales (6 of 57) and the white subterminal lunules on the hindwing upperside are always greatly reduced.

External morphological characters of the immature stages also assist in separating *H. litoralis* from *H. phorbas*. The egg surface structures of both

species are similar, in that both have patterns of reticulated pits and intervening ridges, but *H. litoralis* differs in having the tops of the ridges obtuse and granulated (Fig. 21), while in *H. phorbas* the tops are strongly acute and smooth (Fig. 34); the micropylar depression of the *H. litoralis* egg is smooth with no visible features, while that of *H. phorbas* is strongly ornate with a flowery pattern; the egg of *H. litoralis* is also smaller than that of *H. phorbas*. The mature larva of *H. litoralis* (Figs 24-25) is smaller and, in general, not as brightly coloured as that of *H. phorbas*; the dorsal and dorsolateral stripes of the *H. litoralis* larva are almost always obscured (but sometimes white), but are most often dull greenish-orange and pale green respectively, while the larva of *H. phorbas* has bright yellow and white dorsal stripes and bright greenish-white dorsolateral and lateral stripes (Fig. 36). *H. litoralis* larvae are not known to be polymorphic, while larvae of *H. phorbas* are known to have a number of forms, predominately green and red (Braby 2000) (Figs 35-36). The pupa of *H. litoralis* is smooth and slender, always lime green in colour with no distinctive colour or surface features and with only slight thoracic and abdominal dorsal humps (Figs 27-28); in contrast, the pupa of *H. phorbas* is stout with strongly outlined wing cases, is known to be polymorphic in colour (Parsons 1998, Braby 2000), has yellow spiracles and distinctive thoracic and abdominal dorsal humps (Fig. 37).

In general, apart from structures of the genitalia of the two species, *H. litoralis* can be distinguished from *H. phorbas* by its smaller size and the predominately deep blue-purple upperside of the male, although males are variable (Figs 1, 3), sometimes in the intensity of the colour (some have reflective blue scaling) and shape of the forewing, but most of all in the size and shape of the sex brand. Furthermore, male and female *H. litoralis* tend to be equal in size (forewing lengths: male - 13.14 mm [n=106], female - 13.67 mm [n=57]), as opposed to *H. phorbas*, in which females are larger than males (forewing lengths: male - 16.33 mm [n=103], female - 17.11 mm [n=107]). As a rule, both sexes of *H. litoralis* can be superficially identified by their small size, the deep blue-purple of the hindwing upperside (and most often the forewing) of the male, the absence of a white patch on the forewing upperside of the female and by their close association with mangroves.

To date, *H. litoralis* is known from only four islands in the northern and central parts of Torres Strait, Queensland. Of these, Saibai and Boigu are relatively large in size, flat and muddy with vegetation consisting predominately of mangroves, saltbush and other halophytic species. In contrast, Dauan and Yam Islands are volcanic in origin, have extensive monsoonal vine thickets and much smaller stands of mangroves than the former two islands. Considering the close proximity of Saibai and Boigu (approximately 2 and 3 km respectively) to the Western Province of Papua New Guinea, where large tracts of mangroves also occur, it is highly likely that *H. litoralis* also occurs there. Stands of mangroves and/or resident populations of *O. smaragdina* are known from other Torres Strait islands,

for example to the south and southeast of Saibai Island (south - Zagai and Sassie close to Yam; southeast - Stephens, Aukane, Rennel and Kabbikane) (De Baar 1988 and pers. comm., T.A. Lambkin pers. obs.) and it is possible that the distribution of *H. litoralis* in Australia might be more extensive than is currently known. Braby (2000) provided a useful map of this region, showing the relative positions of all Torres Strait islands discussed.

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Appendix 1. Collection and external character data for types of male *Hypolycaena litoralis* sp. n., voucher specimens 1-106, used for description of species.

No. = Voucher specimen number; **A** = Forewing length (mm); **B** = Forewing scales across sex brand; **C** = Sex brand extending below vein CuA_2; **D** = Blue-purple forewing; **E** = Hindwing subterminal lunules present; **F** = Hindwing subterminal lunules above vein M_2. Y = yes; N = no. Holotype = No. 23.

No.	Collection data		A	B	C	D	E	F
1	Dauan	11.v.2001	14	Y	N	Y	Y	N
2	Yam	11-12.vi.1992	14	Y	N	Y	N	N
3	Dauan	9.v.2001	14	Y	N	Y	N	N
4	Dauan	9.v.2001	13	Y	N	Y	Y	N
5	Dauan	11.v.2001	13	Y	N	Y	Y	N
6	Dauan	1.v.2001	13	Y	N	Y	Y	N
7	Dauan	11.v.2001	13	Y	N	Y	N	N
8	Yam	11-12.vi.1992	15	N	N	N	Y	N
9	Boigu	9.iv.1992	15	Y	N	Y	Y	N
10	Dauan	9.v.2001	13	Y	N	Y	Y	N
11	Dauan	9.v.2001	13	Y	N	Y	Y	N
12	Dauan	11.v.2001	14	Y	N	Y	N	N
13	Dauan	1.v.2001	14	Y	N	Y	Y	N
14	Yam	11-12.vi.1992	15	Y	N	Y	Y	N
15	Dauan	1.v.2001	13	Y	N	Y	Y	N
16	Dauan	11.v.2001	14	Y	N	Y	Y	N
17	Dauan	13.v.2001	14	Y	N	Y	Y	N
18	Dauan	9.v.2001	13	Y	N	Y	Y	N
19	Dauan	9.v.2001	13	Y	N	Y	N	N
20	Dauan	13.v.2001	13	Y	N	Y	Y	N
21	Dauan	9.v.2001	14	Y	N	Y	Y	N
22	Saibai	9.v.2001	12	Y	N	Y	Y	N
23	Boigu	8-9.iv.1992	14	Y	N	Y	Y	N
24	Yam	11-12.vi.1992	12	N	Y	Y	Y	N
25	Boigu	8-9.iv.1992	12	N	N	Y	Y	N
26	Dauan	10.v.2001	13	Y	N	Y	N	N
27	Dauan	27.iv.2000	12	Y	N	Y	Y	N
28	Dauan	9.v.2001	14	Y	N	Y	Y	N
29	Dauan	13.v.2001	13	Y	N	Y	Y	N
30	Boigu	8-9.iv.1992	14	Y	N	Y	Y	N
31	Dauan	11.iv.2001	14	Y	N	Y	Y	N
32	Yam	11-12.vi.1992	14	N	N	Y	N	N
33	Yam	12.vi.1992	14	N	Y	N	N	N
34	Dauan	4.iv.1990	12	Y	N	Y	N	N
35	Saibai	22.iii.1994	14	Y	N	N	Y	N
36	Yam	12.vi.1992	12	Y	N	Y	N	N
37	Yam	12.vi.1992	14	Y	Y	Y	N	N
38	Saibai	27.ix.1992	12	Y	N	N	Y	N
39	Yam	3.iv.1984	13	N	Y	Y	Y	N
40	Yam	3.iv.1984	14	Y	N	Y	Y	N
41	Yam	11-12.vi.1992	14	Y	N	Y	N	N
42	Yam	12.vi.1992	13	N	N	Y	N	N
43	Dauan	13 – 18.iv.2001	13	Y	N	Y	Y	Y

No.	Collection data		A	B	C	D	E	F
44	Dauan	26.iv – 2.v.2002	13	N	N	Y	Y	N
45	Dauan	26.iv – 2.v.2002	12	Y	N	Y	Y	Y
46	Dauan	26.iv – 2.v.2002	13	Y	Y	Y	Y	N
47	Dauan	26.iv – 2.v.2002	12	Y	N	Y	Y	N
48	Dauan	26.iv – 2.v.2002	12	Y	N	Y	Y	N
49	Dauan	26.iv – 2.v.2002	13	Y	N	Y	N	N
50	Dauan	26.iv – 2.v.2002	12	Y	N	Y	Y	N
51	Dauan	26.iv – 2.v.2002	14	Y	N	Y	Y	N
52	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
53	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
54	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
55	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
56	Dauan	26.iv – 2.v.2002	13	N	N	Y	N	N
57	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
58	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	Y
59	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
60	Dauan	26.iv – 2.v.2002	13	N	N	Y	Y	N
61	Saibai	03 – 04.v.2002	13	N	N	Y	Y	Y
62	Saibai	03 – 04.v.2002	13	N	N	Y	N	N
63	Dauan	13 – 18.iv.2001	12	Y	N	Y	Y	N
64	Saibai	19 – 20.iv.2001	13	N	N	Y	Y	N
65	Dauan	26.iv – 2.v.2002	12	Y	N	Y	Y	N
66	Dauan	26.iv – 2.v.2002	13	N	N	Y	Y	Y
67	Dauan	26.iv – 2.v.2002	13	Y	N	Y	N	N
68	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
69	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
70	Dauan	26.iv – 2.v.2002	13	Y	N	Y	Y	N
71	Dauan	26.iv – 2.v.2002	13	N	N	Y	N	N
72	Saibai	25.iv.2002	13	N	N	Y	Y	N
73	Dauan	Emg: 05.v.2002	13	Y	N	Y	Y	Y
74	Dauan	Emg: 12.v.2002	13	Y	N	Y	Y	N
75	Dauan	Emg: 14.v.2002	13	Y	N	Y	Y	N
76	Dauan	Emg: 16.v.2002	12	Y	N	N	N	N
77	Dauan	Emg: 12.v.2002	12	Y	N	N	Y	Y
78	Dauan	Emg: 18.v.2002	13	Y	N	N	Y	N
79	Dauan	26.iv – 2.v.2002, em 04.v.2002	13	Y	N	Y	Y	Y
80	Dauan	26.iv – 2.v.2002, em 04.v.2002	13	Y	Y	Y*	Y	Y
81	Dauan	26.iv – 2.v.2002	12	Y	N	Y	N	N
82	Dauan	26.iv – 2.v.2002	12	Y	N	Y	N	N
83	Dauan	26.iv – 2.v.2002, em 04.v.2002	13	Y	N	Y	N	N
84	Dauan	26.iv – 2.v.2002, em 05.v.2002	14	Y	N	Y*	Y	N
85	Dauan	26.iv – 2.v.2002, em 05.v.2002	13	Y	N	Y	N	N
86	Dauan	pupa coll 17.ii.2004	14	Y	N	Y	Y	N
87	Dauan	pupa coll 17.ii.2004	14	Y	N	Y	Y	N
88	Yam	3.iv.1984	13	N	N	Y	Y	N
89	Yam	3.iv.1984	14	Y	N	Y	N	N

No.	Collection data		A	B	C	D	E	F
90	Dauan	13.iv.1994	14	Y	N	Y	Y	N
91	Dauan	4.iv.2004	13	Y	N	Y	N	N
92	Dauan	9.iv.2004	13	Y	N	Y	Y	N
93	Dauan	9.iv.2004	13	Y	N	Y	Y	Y
94	Dauan	12.iv.2004	12	Y	N	Y	N	N
95	Dauan	12.iv.2004	14	Y	N	Y	Y	Y
96	Dauan	12.iv.2004	12	Y	N	Y	Y	Y
97	Dauan	12.iv.2004	13	Y	N	Y	Y	Y
98	Dauan	em. 16.iv.2004	13	Y	N	Y	N	N
99	Dauan	10.iv.2004	13	Y	N	Y	Y	N
100	Dauan	10.iv.2004	13	Y	N	Y	N	N
101	Dauan	em. 14.iv.2004	12	Y	N	Y	N	N
102	Dauan	em. 18.iv.2004	13	Y	N	Y	Y	N
103	Dauan	em. 19.iv.2004	14	Y	N	Y	Y	N
104	Dauan	em. 19.iv.2004	14	Y	N	Y	N	N
105	Dauan	em. 19.iv.2004	13	Y	N	Y	Y	N
106	Dauan	em. 22.iv.2004	15	Y	N	Y	Y	Y

* = white scales on forewing.

Appendix 2. Collection and external character data for types of female *Hypolycaena litoralis* sp. n., voucher specimens 1-57, used for description of species. Y = yes; N = no.

Voucher specimen No.	Collection data		Forewing length (mm)	Forewing with white scales
1	Dauan	12.v.2001	15	N
2	Dauan	9.v.2001	14	N
3	Dauan	9.v.2001	15	N
4	Dauan	11.v.2001	14	N
5	Dauan	9.v.2001	14	N
6	Dauan	11.v.2001	13	N
7	Dauan	9.v.2001	14	N
8	Dauan	13.v.2001	14	N
9	Dauan	9.v.2001	14	N
10	Dauan	9.v.2001	13	N
11	Dauan	9.v.2001	14	Y
12	Dauan	9.v.2001	15	Y
13	Dauan	13.v.2001	14	N
14	Dauan	9.v.2001	13	N
15	Boigu	21.iii.1994	15	N
16	Boigu	21.iii.1994	13	N
17	Dauan	13 – 18.iv.2001	15	Y
18	Dauan	26.iv – 2.v.2002	14	N
19	Dauan	26.iv – 2.v.2002	14	N
20	Dauan	26.iv – 2.v.2002	14	Y
21	Dauan	26.iv – 2.v.2002	14	N
22	Dauan	26.iv – 2.v.2002	14	N
23	Dauan	26.iv – 2.v.2002	14	N
24	Dauan	26.iv – 2.v.2002	13	N

Voucher specimen No.	Collection data		Forewing length (mm)	Forewing with white scales
25	Dauan	Emg: 05.v.2002	14	N
26	Dauan	13 – 18.iv.2001	14	N
27	Saibai	19 – 20.iv.2001	14	N
28	Saibai	19 – 20.iv.2001	15	N
29	Dauan	26.iv – 2.v.2002	13	N
30	Dauan	26.iv – 2.v.2002	14	N
31	Dauan	26.iv – 2.v.2002	14	N
32	Dauan	26.iv – 2.v.2002	13	N
33	Dauan	Emg: 03.v.2002	14	N
34	Dauan	Emg: 10.vi.2002	14	Y
35	Dauan	Emg: 07.vii.2002	13	Y
36	Dauan	26.iv – 2.v.2002, em 03.v.2002	13	N
37	Dauan	26.iv – 2.v.2002, em 03.v.2002	14	N
38	Dauan	26.iv – 2.v.2002, em 03.v.2002	12	N
39	Dauan	26.iv – 2.v.2002, em 04.v.2002	12	N
40	Dauan	26.iv – 2.v.2002, em 05.v.2002	14	N
41	Dauan	26.iv – 2.v.2002	13	N
42	Boigu	12.iv.1992	13	N
43	Saibai	27.ii.2004	14	N
44	Dauan	12.iv.2004	12	N
45	Dauan	em. 12.iv.2004	13	N
46	Dauan	em. 12.iv.2004	14	N
47	Dauan	em. 13.iv.2004	13	N
48	Dauan	em. 14.iv.2004	12	N
49	Dauan	em. 23.iv.2004	14	N
50	Dauan	10.iv.2004	14	N
51	Dauan	em. 12.iv.2004	13	N
52	Dauan	em. 14.iv.2004	14	N
53	Dauan	em. 14.iv.2004	13	N
54	Dauan	em. 18.iv.2004	15	N
55	Dauan	em. 18.iv.2004	13	N
56	Dauan	em. 18.iv.2004	13	N
57	Dauan	em. 20.iv.2004	13	N